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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No. 08/941,832	Applicant(s) Chacon
	Examiner Hugh Jones	Group Art Unit 2123

[X] Responsive to communication(s) filed on *Oct 10, 2000*

[X] This action is **FINAL.**

[ ] Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle* 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire *3* month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

[X] Claim(s) *37-50* is/are pending in the applicat

Of the above, claim(s) ______ is/are withdrawn from consideration

[ ] Claim(s) ______ is/are allowed.

[X] Claim(s) *37-50* is/are rejected..

[ ] Claim(s) ______ is/are objected to.

[ ] Claims ______ are subject to restriction or election requirement.

Application Papers

[ ] See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

[ ] The drawing(s) filed on ______ is/are objected to by the Examiner.

[X] The proposed drawing correction, filed on *Oct 10, 2000* is [X] approved [ ] disapproved.

[ ] The specification is objected to by the Examiner.

[ ] The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

[ ] Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

[ ] All [ ] Some* [ ] None of the CERTIFIED copies of the priority documents have been

[ ] received.

[ ] received in Application No. (Series Code/Serial Number) ______ .

[ ] received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: ______

[ ] Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

[X] Notice of References Cited, PTO-892

[ ] Information Disclosure Statement(s), PTO-1449, Paper No(s). ______

[ ] Interview Summary, PTO-413

[ ] Notice of Draftsperson's Patent Drawing Review, PTO-948

[ ] Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

DETAILED ACTION

Information Disclosure Statement

1. References to non-patent literature is suggested in the specification (*Backround of the invention*). These disclosures appear to be very relevant to the instant invention and claims. As these references are not readily available to the Examiner, the applicant should provide the office with copies of the references in any response to this action.

2. Applicant is **reminded** of their duty to disclose all information material to the patentability of the application.

> 37 C.F.R. 1.56 Duty to disclose information material to patentability.
>
> (a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection

with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a *prima facie* case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(I) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A *prima facie* case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. **Claims 37-50 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential elements, such omission amounting to a gap between the elements.** See MPEP § 2172.01.

- simulator: the simulator has not been described;

- production scheduling model: this has not been described.

- virtual/electronic Kanban: this has not been described.

5. **Claims 37-50 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps.** See MPEP § 2172.01. The omitted steps are:

- simulation: the steps have not been described.

- determine the validity of the Kanban: how is this done?

- controlling a manufacturing line: how is this done?

- claim 37: what happens if the Kanban is not determined to be valid?

6. **Claims 37-50 provides for the use of *controlling a manufacturing line*, but, since the claim does not set forth any steps involved in the method/process, it is unclear what method/process applicant is intending to encompass.** A claim is indefinite where it merely recites a use without any active, positive steps delimiting how this use is actually practiced. There are no limitations directed at anything more than generation of a schedule.

Claim Interpretations

7. The Examiner interprets the invention to be: ***real-time optimization of a production routing schedule using feedback as input to a simulator***. The Examiner also interprets *electronic/virtual Kanban* to be electronic tracking of items in a manufacturing line. These concepts have been disclosed in the prior art.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. **Claims 37-50 are rejected under 35 U.S.C. 102(a) as being clearly anticipated by De Toni et al..**

10. De Toni et al. disclose "*An artificial, intelligence-based production scheduler.*" They further disclose a ***production scheduler, which utilizes a hybrid push/pull approach to scheduling and exploits the expert system technology in order to obtain satisfactory solutions.*** The scheduler is applied to a multi-stage production and inventory system, managed by make-to-order, with a large variety of incoming orders. The search for solution is made in respect of the due-dates and under efficiency constraints (minimum lot, maximum storehouse levels, etc.). Considers order aggregation, both at portfolio and production level. ***Provides a dynamic rescheduling mechanism***. Outlines theoretical arguments in favour of the scheduler and notes practical advantages as a consequence of the application of the scheduler in a firm which utilized a traditional despatching system. Page 23 discloses "*The expert system solution*". Several outlines regarding expert system applied to production scheduling have been made [19, 20]; some complete schedulers have been constructed (ISIS is probably the most famous expert system for scheduling) and in the literature there are detailed comparisons [21]. A decision support system (DSS) solution has been proposed too [22]. At other times the simple weakness of traditional approaches has been remarked on [23,24]. ***Particular attention is dedicated to the possibility of an effective rescheduling (or dynamic scheduling) [25-28]***. The advantages of the expert system technology in scheduling have been noted by several researchers [29,30] and can be summarized as the possibility of a selective relaxation of the constraints and the use of heuristics to restrict the

number of alternatives and assist in selecting the best solution. Resorting to sub-optimal solutions (typical of the expert systems) is necessary since little advance has been made towards finding optimal solution procedures for models of a realistic size. Carrying out research on sub-optimal solutions using heuristic rules would lead to very inter-esting results [31]. This scheduler is original in the application of a hybrid pull/push approach (rising step profile + supplementary load) by an expert system. The scheduler has a constraint-directed chaining (according to the five classes described by Kusiak[32]: hierarchical, non-hierarchical, script-based, opportunistic and constraint-directed); constraints provide guidance and bounds in the search for good schedules. This scheduler uses some blackboard techniques of the type hypothesized by Hayes-Roth [33]. The production scheduling black-board consists of frames, lists and rules of the IF/THEN type, plus a blackboard controller with a shopfloor control system interface and codes/routeings archives. The status of the work centres, the backlogs and the functional parameters are described by frames; the status of the storehouses and of the order portfolio are instead in the form of lists. The reasoning logic is described by about 200 rules, in lisp-like language. For production scheduling problems, the main advantage of a blackboard control is simplicity of rule drafting and their insertion into the knowledge base, without having to be placed at a precise point in the knowledge base and solely as an enrichment of the knowledge base itself, on which the inferential engine acts. See pp. 22-23 (hybrid push/pull approach); pg. 23 (expert system).

11. **Claims 37-50 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Umeda et al. (U. S. Patent 5,544,348 - of record) or Seppanen (IEEE, 1993 - of record) or**

Wiwakanond et al. (of record) or Corbett et al. (of record) or Tantry et al. (of record) or Natarajan (of record) or Parad (of record) or Korncoff et al. (of record) or Weaver et al. (of record) or Lee et al. (of record) or Liberatore et al. or Jain et al. or Roberts et al. or Umeda (IEEE) or Bouchentouf-Idriss et al. or Harmonosky or Marriott or Krishnamurthi et al. or Manivannan et al..

12. Umeda et al. teaches simulation of a Kanban system. See entire disclosure and particularly: abstract; figs. 1-15; col. 1, lines 42-55; col. 3, lines 48-67; col. 3, lines 1-48; col. 10 lines 1-67; col. 18, lines 10-67.

13. Seppanen teaches: "Kanban Simulator using Siman and Lotus 1-2-3." See particularly: abstract; and pp. 838-844.

14. Wiwakanond et al. teach "Simulation of Electronics Manufacturing Systems with Two-Card Kanban." See particularly: entire disclosure.

15. Corbett et al. disclose a review of papers concerning simulations of scheduling systems, including Kanban systems. See particularly: abstract; sections 2-3, and list of references.

16. Tantry et al. disclose "*Object-oriented architecture for factory floor management.*" The abstract discloses: "***An object-oriented architecture for a factory floor management software system is described in which factory floor entities are modelled as factory objects within a relational database. The architecture includes X-terminal or bar code devices for facilitating user interaction with the system via one or more of the factory floor entities; Application Engines for processing user interaction of events and generating application service requests;***

and Application servers for processing the application service requests and generating database service requests in response. These database service requests are utilized to retrieve, manipulate and update data stored within the relational database. Communication Managers are employed for coordinating interprocess communication between the Application Engines, the Application Servers, and the Database Servers. Each of these major components are distributed among computer resources that are networked across the factory floor." See, also: fig. 2-3, 5-10; col. 1, line 38 to col. 2, line 46; col. 5, line 45 to col. 9, line 30; Table 1 (col. 20).

17. Natarajan discloses (abstract): "*A conceptual decision analysis tool for production dispatch process is used to evaluate alternatives during a production process and generate an optimum path to follow after a process disruption at a given production center in order to maintain the promised due date. The objective is not only to decide on a dispatch rule to be followed for an order under progress at a given work center in the event of a disruption, but also to re-analyze dispatch rules for existing orders waiting in line to be processed at that work center. In the event of production stoppage or disruption, this system analyzes the revised sequence for orders in progress as well as passes the recommended results to a planning system so that this information can be used to re-plan the release sequence of orders waiting for release. This provides a feedback control mechanism and an element of artificial intelligence.*" See, also: fig. 2-3; col. 2, line 26 to col. 3, line 10.

18. Parad discloses (abstract): "*A method for continuous real-time management of heterogeneous interdependent resources is described. The method preferably comprises using*

multiple distributed resource engines to maintain timely and precise schedules, and action controls, and identifying and responding to rapidly changing conditions in accord with predetermined requirements, relationships, and constraints. Each resource engine continuously adjusts schedules in response to changing status, resource requirements, relationships and constraints. Each action control maintains an ordered list of conditions requiring action, determines the best action in each case, and generates appropriate responses. Preferably methods for continuous operation include inquiring about status concurrent with scheduling activity and recognizing the effects of time passage on the condition of schedules." See, also: fig. 1-2, 6, 8-9, 11-12, 17-19; col. 2, line 1 to col. 5, line 64.

19. Korncoff et al. discloses (abstract): "An exception ***processing system for use in conjunction with manufacturing facilities, and automated manufacturing cells in particular is provided. The exception processor is adapted to receive alarms from a cell controller indicating that an unplanned event or exception has occurred in cell operation. The exception processor implements an automated recovery procedure that responds to the alarm, corrects the exception, and returns the cell to normal operation. The exception processor also statistically monitors cell operation in order to avoid exceptions before they occur, and to provide better control over cell processes.***" See, also: fig. 1-2, 5, 7, 12, col. 1, lines 24-46; col. 2, line 1 to col. 4, lne 23.

20. Weaver et al. discloses (abstract): "This invention is a look-ahead method for determining ***optimum production schedules*** for each production step based on factory-wide monitoring of in-process part queues at all potential production bottlenecks. For each product having associated therewith a

throughput bottleneck, a maximum queue quantity Q.sub.MAX and a minimum queue Q.sub.MIN quantity are assigned. When a machine completes a lot of a particular product at a production step P that proceeds the bottleneck step B, the ***look-ahead method*** is initiated. The queue at step P is searched and the next lot to be processed is selected. ***If that lot is a product for which Q.sub.MAX and Q.sub.MIN values have been assigned at step B, then the queue quantity at step B is determined. If, on one hand, the queue quantity at step B is less than Q.sub.MAX, or between Q.sub.MAX and Q.sub.MIN and the queue quantity is climbing upward from a sub-Q.sub.MIN value and has not yet exceeded its Q.sub.MAX value, then the lot is processed without further analysis. If, on the other hand, the queue quantity at step B is greater than Q.sub.MAX , or between Q.sub.MAX and Q.sub.MIN and the queue quantity is descending from a quantity greater than its Q.sub.MAX and has not yet fallen below its Q.sub.MIN value, then that product has a set flag status associated therewith, and the lot will not be processed until after all other lots which have a clear flag status are processed***." See, also: fig. 3; col. 1, line 16 to col. 2, line 26.

21. Lee et al. discloses a lookahead production planning system. The abstract discloses: ***"An integrated manufacturing system operative for managing the distribution to a factory floor as well as throughout a factory of the information that is necessary to effectuate the production of products on the factory floor. The information required for this purpose encompasses, but is not necessarily limited to, both the design information which is generated within the engineering enterprise and the scheduling information which is generated within the manufacturing resource planning system. This information consisting of design and manufacturing data pertaining to the***

product to be produced is in turn stored in a central repository for all shared information from whence as needed it is capable of being distributed in a logical and efficient fashion through operation of the integrated manufacturing system to the factory floor as well as throughout the factory so as to thereby enable the product to be produced on the factory floor in a most timely and most cost-effective manner." See, also: fig. 1, 3-4, 6, 15-16, 18-20, 23-28; col. 3, line 60 to col. 6, line 27.

22. Liberatore et al. disclose "*Dynamic allocation of kanbans in a manufacturing system using perturbation analysis.*" They further disclose an application of perturbation analysis techniques to the problem of dynamic allocation of buffering capacity in a multipart-type manufacturing system. The problem is of extreme interest, among others, in kanban systems. The first contribution of the paper consists of a formulation of the generation function for the case of buffer size perturbation. *The second contribution consists of an online control strategy, aimed at dynamically varying the buffering capacity of the working centres, in order to keep the performance of the system as high as possible, despite unknown disturbances entering the system. The proposed control strategy has been tested by means of simulation on a multipart-type kanban system.* The control action consists of dynamically varying the number of kanbans associated to each part-type, in order to counteract the effect of unknown changes in the product-mix on the system throughput. See section 1 which discusses an on-line control strategy (developed in section 4).

23. Jain et al. disclose "*Expert Simulation For On-line Scheduling.*" They further disclose

that, in recent years, the automotive industry has realized the importance of speed of new products to market and has mounted efforts for improving it. ***The Expert System Scheduler (ESS) facilitates these efforts by enabling manufacturing plants to generate viable schedules under increasing constraints and demands for flexibility. The scheduler takes advantage of the Computer Integrated Manufacturing (CIM) environment by utilizing the real-time information from the factory for responsive scheduling. The Expert System Scheduler uses heuristics developed by an experiences factory scheduler. It uses simulation concepts and these heuristics to generate schedules. Forward and "backward" simulation are used at different stages of the schedule generation process. The system is used to control parts flow on the factory floor at one automated facility.*** This highly automated facility is a testbed for implementation of CIM concepts. The scheduler runs on a Texas Instruments (TI) Explorer II computer using software developed inhouse utilizing IntelliCorp's Knowledge Engineering Environment (KEE) shell and the LISP language. ***The scheduling computer is networked to the factory control computer, which actually controls the plant floor.*** The TI Explorer II acquires current plant floor information from the factory control system, generates a new schedule and sends it back within a short time. The configuration allows fast response to changes in requirements and plant floor conditions. See section 2 (expert systems approach); section 3 (use of simulation); and fig. 1-2 (implementation of combined on-line system).

24. Roberts et al. discloses in section 5 (*CONTROL SPECIFICATION SIMULATION ASSISTANT*) that often control code errors am not detected until the code is tested on the actual

process. On-line validation can be extremely costly since process equipment must be out of production during the testing process. An alternative solution is to use computer simulation to reduce the validation time. Computer simulation for control code validation can also be very costly to perform. A simulation model must be created which can interact with the actual control specification. Inputs to the system must be analyzed and distributions formed. It is also desirable to have some inputs that the operator controls. Controls such as push buttons, levers, dials in the actual system need to be represented and available for input to the simulation. The operator of the simulation model must also be able to provide these inputs in a pseudo real-time mode. Fortunately, part of the simulation specification is already available. The physical specification of the virtual plant and the process specification already contain information that is needed for the simulation model. As has been mentioned, each piece of equipment has an object oriented sofhvare map called an instance. The object oriented approach allows us to add functionality to the object for simulation purposes. For example, we may have an instance of a mixing tank. This mixing tank instance has a data structure for current level and for its own iconic representation. The encapsulated procedure for the mixing tank object will include the ability to display itself and the ability to display its current level. The control simulation is conducted using a next event calendar and the keyboard for system inputs. Many inputs are modeled with distributional functions, however, many of the inputs to the model come from a manual input source. To achieve this the inputs are tied to the keyboard with the aid of the control specification simulation assistant. A pseudo real-time simulation is maintained using fixed time increment updates

generated by the computer clock. This update scheme gives the user the ability to interact dynamically by evoking system events. With each time increment the calendar is also checked for scheduled mndom events. *As new input events occur, the simulation assistant processes the changes in system states and maps these states to the generic control code specification produced by the control code generator assistant. System states are updated based on the specification by sending messages to the equipment instances.* The equipment instances receive these messages and update their own internal states which are then displayed on the monitor. See fig. 1; section 5 (control specification simulation assistant).

25. Umeda discloses in section 6 (*ADVANCED SIMULATION SYSTEM FOR PRODUCTION PLANNING AND CONTROL SYSTEM*) that thus far, the author have suggested a manufacturing system simulator. In this section, Umeda proposes an advanced simulation system, which includes the above simulator as its a kernel module. It also includes a graphic post-processor, a model generator, and a schedule evaluator. A system configuration is shown in Figure 9. The graphic post-processor supports graphic charts which represent the output analysis data of simulation. The model generator gets both the system configuration and the manufacturing schedules, and generates the simulation model automatically, The schedule evaluator provides the facility of manufacturing scheduling simulation. *There exist two types of manufacturing simulation to support planning and control operations in a factory off-line simulation and* ***on-line simulation***. The former is an assessment at design and planning stages. Manufacturing engineers mainly discuss the system configuration, such as buffer size, machine capacity, vehicle speed and others.

This operation supports the analysis works such as systems planning or line improvement. These works require simulation independently on daily manufacturing operations. ***On the other hand, the on-line simulation supports the daily plant control operations. The main input parameters of the on-line simulation are daily manufacturing schedules***. MPSIMRP produces the daily manufacturing schedules at production planning phase. While, planning changes or line-troubles often occur in daily manufacturing practice. Accordingly, manufacturing field workers require so-called re-scheduling operations to synchronize their field works with the plans. Re-scheduling operation requires special skill of operators. Furthermore, it takes much time to select one among many possible schedules. ***Repeats of simulation with different scheduling parameters will support such real-time re-scheduling operation. This operation requires a high performance of simulation, and dynamic changes of the simulation parameters in real-time scale.*** The model generator and the schedule evaluator will provides such works. The former directly rewrites the manufacturing schedules in the simulation model, such as the shipment orders lists and part-throw lists, and the later estimates whether the given schedule is executable or not.

"Virtual Plant System" is a concept which combines real-time monitoring system with on-line factory simulation by computer network (Figure. 10). The real-time monitoring system observes all the data of main activities at each plant Iayec such as production orders, venders actions, WIPS changes, machine-downs, and others. And, it periodically sends these data to the parameters generator. The parameters generator transfers them to simulation parameters, and send them to the on-line factory simulator, which has a hierarchical model of multiple

lines or sections. Thus, the simulator can realize the same situation as the actual plant by the latest information. While, a planning system such as MPSIMRP sends the plant control information to both the actual plant and the virtual plant. In this environment, simulation can realize the same material flow and information flow as the actual plant in computer. Such environment will enable manufacturers to predict the key events of plant, whenever a new direction is performed. This will be a great support for manufacturers to make decisions in plant operations. See pg. 892 (Kanban, Pull); section 2.4 (Siman); section 6 (real-time simulation and process control)

26. Bouchentouf-Idriss et al. disclose that the absence of CASE tools for software-development of distributed cooperative systems is the major roadblock to effective use of concurrent processing. This paper presents a manufacturing engineering application, a concurrent cooperative processing model of this application, and the Server Network Generator (SNG) CASE tool that was used to *design and implement it as a distributed software system* in APL2, using inter-user shared variables. The application is a Japanese manufacturing control strategy called the "*Kanban System.*" See pp. 62-66 (Kanban); pp. 66-68 (electronic Kanban, emulation);

27. Harmonosky discloses in section 2 (SIMULATION INTERFACED WITH THE PHYSICAL SYSTEM) that in most of the reported research using ***simulation for real-time scheduling, the simulation is assumed to be interfaced with the physical system in some manner. Figure 1 presents a typical viewpoint for the interface for exeeption real-time***

scheduling, which could be easily modified for continuous real-time scheduling. Data regarding system status updates the simulation initial conditions when a decision is needed, either on an exception basis or continually. If alternatives exist, each would be simulated and the best could be selected, or the simulation would be run to predict future problems. The research discussed in this section uses this basic interfacing theme with a few variations. ***Harmonosky also reviews the prior art concerning Continuous Real-Time Scheduling Approaches*** in section 2.1. Continuous real-time scheduling refers to the case where every decision regarding which task to schedule next is made as needed as time moves forward in the physical system. ***Krishnamurthi and Vasudevan (1993) present a framework for a domain-based on-line simulation, which they suggest could be used as a general purpose decision support system***. The objective is to create something general to all problems within a specific domain where the simulation is continuously monitoring the real system so that it always reflects current system state. Their framework consists of several modules a simulation module, a simulation control module, static and dynamic databases, a data acquisition module, and a customization module. A prototype is developed for the domain of a single queue with multiple parallel servers. The objective is to determine the number of parallel servers to minimize queue length and waiting time as system conditions change over time. ***The prototype uses Turbo C to pass data between computers, the SIMAN simulation language and the CLIPS expert system as a knowledge base to check if a prior decision exists that can be used without a new simulation. The time saved by the developed prototype system was 3070 of the time taken by***

an off-line simulation process. Smith et al. (1994) use simulation as a task generator in addition to an analysis and evaluation tool. A simulation of the physical system acts as adecision maker determiningwhat task must occur next and sends that task to the execution software for the system. ***Using simulation as a shop floor control mechanism was developed as part of a larger joint project, RapidCIM, with Texas A&M University, Penn State University, and Systems Modeling Corporation.*** This project's overall objective is to reduce the time required to develop fully functional shop floor control systems for flexible discrete parts manufacturing. Consequently, the control logic developed and used for the simulation becomes the physical system's control system, reducing time between the simulation analysis phase and physical system implementation. Special features of the Arena/SIMAN simulation language are used to enable direct interfacing with physical system data and to enable switching the simulation between off-line analysis mode and on-line task generator mode. The reported control svstem is deveioped for Texas A&M's Computer' Aided Manufacturing lab and Penn State's CIM lab where it provides direct continuous control of shop activities. Currently, the system does not evaluate several alternative tasks at each decision point. However, the authors do suggest that it could be used to evaluate multiple alternatives by making a copy of the simulation that can be initialized with the current physical system state and run into the future. Duffie and Prabhu (1994) present a heterarchical manufacturing system that uses simulation to evaluate local schedules that are continually developed by local controllers. The system has loosely coupled, highly autonomous entities having minimal global information. All entities develop their own local

schedule and "cooperate" to meet global goals. The local and global merits of these local schedules are evaluated by a simulation that is developed by modifying the physical systems control software. See fig. 1.

28. Marriott discloses in section 1.1 (*TRADITIONAL SCHEDULING*) that without computer based scheduling most plants will plan production one of two ways, either they will generate schedules by hand, or will not schedule and run by means of "Hot-Lists". When the detail schedule is created by hand it is usually done on a magnetic board or drawn on paper. For all but the most simple sites, the time required to do this is prohibitively large unless short cuts are taken. These schedules usually take the form of a Gantt chart so a scheduler can quickly analyze the volume ofinformation involved. The use of a Gantt chart also highlights the time dependent nature of the scheduling process. Most manufacturing consists of several consecutive operations that are defined for a part. These operations must be performed sequentially using one or more manufacturing resources. The availability of the PROVISA (Production Visual Interactive Scheduling Aid) is a finite capacity scheduling system geared for manufacturing facilities. While the mechanisms behind PROVISA are based upon AT&T ISTELS simulation technology there are several features that differentiate a simulation based scheduling system from a general purpose simulator. A general purpose simulator is usually a model centric tool. The purpose of the system is to analyze how the model performs. It is normally used by modifying how the model works. To initialize the model a warm-up period based on statistical generalizations may be used. The system

uses a stochastic simulation engine to generate the variability in the output that is useful for analysis (with a confidence level after a number of runs). These simulation models usually have a finite life, when the analysis is complete the model is rarely used again, A simulation based scheduling system is data centric. ***A scheduler must produce specific items that will fulfill some demand. To initialize the model the actual status from the plant floor must be used. A scheduling system must produce a "good" solution in a minimum time in order to be effective. This leads a simulation based scheduling system to use a deterministic model instead of a stochastic one.*** In addition, the benefits of a statistical based output do not fit into the scheduling environment. As an example, breakdowns generally occur in a random fashion. Since the exact time that a breakdown will occur is impossible to predict, it is impossible to schedule. In this case, it is better to generate a schedule based upon the best data available, and reschedule when and if the breakdown occurs. Lastly, a scheduling model has a much longer life than a simulation model. A scheduling model is expected to survive for many years of daily use with little or no modification. While both types of systems encourage "What-if' experimentation, a scheduling system is working with tangible things while a simulation package models things that "could be". These differences between the two highlight the mode in which they are applied. When used for scheduling the simulation is tactical, however when it is used for simulation it is strategic. Section 3 (*ELEMENTS FOR SCHEDULING*) discloses that for a scheduling system to be a useful tool it must be able to do the same functions as the manual scheduler. Specifically, it must generate the expected start and completion dates for the operations that are to be performed and it must able

to analyze this data to determine its acceptability. To perform these functions the scheduling system needs to provide several capabilities:

- Incorporate the logic of how a site produces its goods.

- Handle any manufacturing mechanisms that the site uses, for example, JIT, ***Kanban***, Theory of Constraints.

- Provide flexibility when unexpected conditions arise.

- Help the scheduler analyze the resultant schedule to determine the desirability of the schedule.

- Create an output of the schedule that is useful in the operational environment.

To accomplish this, PROVISA is organized as shown in Figure 1. The data is manipulated through the simulation engine. The resultant data is analyzed through generated reports, and the Comparison and Planning Board modules. If the first schedule is not satisfactory then PROVISA offers several options that allow refinement through iteration. See fig. 1 & 4.

29. Krishnamurthi et al. disclose the state of the prior art regarding on-line simulation in section 2 (*PAST RESEARCH ON ON-LINE SIMULATION SYSTEMS*). The major components of on-line simulation systems discussed in the existing literature generally consist of a data acquisition module, a simulation model and a control program. Additional features such as ***expert systems and knowledge bases are also included in some on-line simulation systems. Past research in on-line simulation has focused mainly on production scheduling and monitoring and control*** and they are briefly discussed in the following sections. Section 2.1 discloses *On-Line*

Simulation for Real-Time Scheduling. A ***major portion of the past research has been on on-line real-time scheduling of manufacturing systems. Rogers and Flanagan (199 1) have developed a framework for an on-line simulation system for real-time scheduling. The on-line simulation system gets shop floor status, material plan and planning options and evaluates the performance of these options. The output is analyzed by production control personnel or an expert system to come up with the best alternative. This framework is applicable for real-time scheduling in manufacturing industries. Jain et al. (1989) used an on-line simulation system in the development of an Expert System Scheduler. The framework used in this system consists of an Expert System Scheduler and a Factory Control System. The scheduling computer acquires shop floor information from the factory control computer, generates a new schedule based on simulation runs and sends it back to the factory control computer. The factory control computer interacts with the shop floor, materials department and the marketing department to get the necessary input and to send the new schedule. The simulation models have been developed using LISP and they use backward chaining concept to go from the desired output to the necessary input. On-line simulation was used in a work order release mechanism for a flexible manufacturing system developed by Muller et al. (1990). The framework of this system consists of a simulation model and a control system interface. The simulation model acquires necessary data directly from the databases. The model is run by the control system interface for a spectiled time window to find the effect of various order release policies. The analyst selects the best schedule based on simulation***

results. The simulation model was written in SIMAN and the data interfaces were developed in FORTRAN. Section 2.2 discloses On-Line Simulation for Monitoring and Control. On-line control of a manufacturing cell was achieved by Manivannan and Banks (1991). The framework of this system contains knowledge bases, databases, simulation models and control interfaces. The model monitors the cell continuously and the user initiates the system emulation any time a control decision is needed, A knowledge base is used to selectively simulate alternatives for which prior knowledge does not exist. The simulation models are written in SIMAN and the knowledge bases are written in LISP. Based on this system, Manivannan and Banks have come up with a design for a knowledge-based on-line simulation system to control a manufacturing shop floor. Manivannan and Banks (1990) have also developed an on-line knowledge based simulation system for diagnosing machine tool failure. The framework of this system is similar to the previous system. The data from sensory devices is analyzed by a controller and thesimulation model is used to calculate the time of failure of machine tool whenever an impending failure is sensed. A knowledge base stores the results which are used for eliminating simulation runs if prior knowledge exists. On-line simulation systems have also been used in other applications such as signalized intersection control for evaluating various signal control strategies by Chang (1989), and in developing efficient and flexible operations and training of air tratlic control trainees by Kornecki et al. (1991). See fig. 1-3.

30. Manivannan et al. disclose "***Real-time control of a manufacturing cell using knowledge-based simulation.***" They further disclose that the need for integrated simulation environments for modeling and analysis is advanced. A mathematical framework based on higher-level abstractions representing entities, attributes, constraints, and other components of manufacturing cells is presented. A manufacturing cell has been modeled to illustrate the framework and real-time control issues using knowledge-based simulation. A temporal knowledge base has been designed to synchronize the events and their times of occurrence in both the manufacturing cell and the simulation model. A dynamic knowledge base has been implemented using frame structures for storing the results of simulation. This feature provides a faster response to a control problem by reducing the number of resimulations conducted for evaluating various alternative policies in real time. The proposed real-time knowledge-based simulation system has been applied to a manufacturing cell connected to a variety of materials handling systems.See fig. 1 & 6 (real-time control, feedback and simulation).

Response to Arguments

31. Applicant's arguments filed 10/10/00 have been fully considered but they are not persuasive. Applicant is disclosing ***real-time optimization of a production routing schedule using feedback as input to a simulator***. This has been disclosed in the prior art. Examiner has attempted to point out to Applicant that any disclosure regarding simulation of a Kanban system would read on the independent claims *as they have been drafted*.

32. As per remarks attributed to the Examiner by the Representative (pg. 7, paper # 20), the Examiner respectfully, but strongly, ***takes exception*** to the ***inaccurate characterization*** of Examiner's remarks during the personal interview. ***The Representative was provided the courtesy of a two-hour interview in an attempt to resolve the outstanding issues in the co-pending applications.*** The Examiner did provide the following argument (among many others). The claims, as recited, merely claim a simulation - any art regarding simulation of a Kanban would therefor read on the claims. In response to applicant's arguments, the recitation *controlling a manufacturing process* has not been given patentable weight because the recitation occurs in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (CCPA 1976) and *Kropa v. Robie*, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951). Furthermore, in response to applicant's argument that "*Applicant is not claiming a simulation of a Kanban system...*" (pg. 7, paper # 20), a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152

USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). *Functionally, Applicant has merely claimed a simulator which uses real-time feedback data in its simulation.*

33. It is also noted that Representative has not discussed the specific art rejections (but has stated that the amendments were not made to overcome the art of record). Applicant's arguments therfore fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references.

Conclusion

34. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

35. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

36. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Hugh Jones whose telephone number is (703) 305-0023.

Eric W. Stamber

ERIC W. STAMBER
PRIMARY EXAMINER

Dr. Hugh Jones

January 1, 2001